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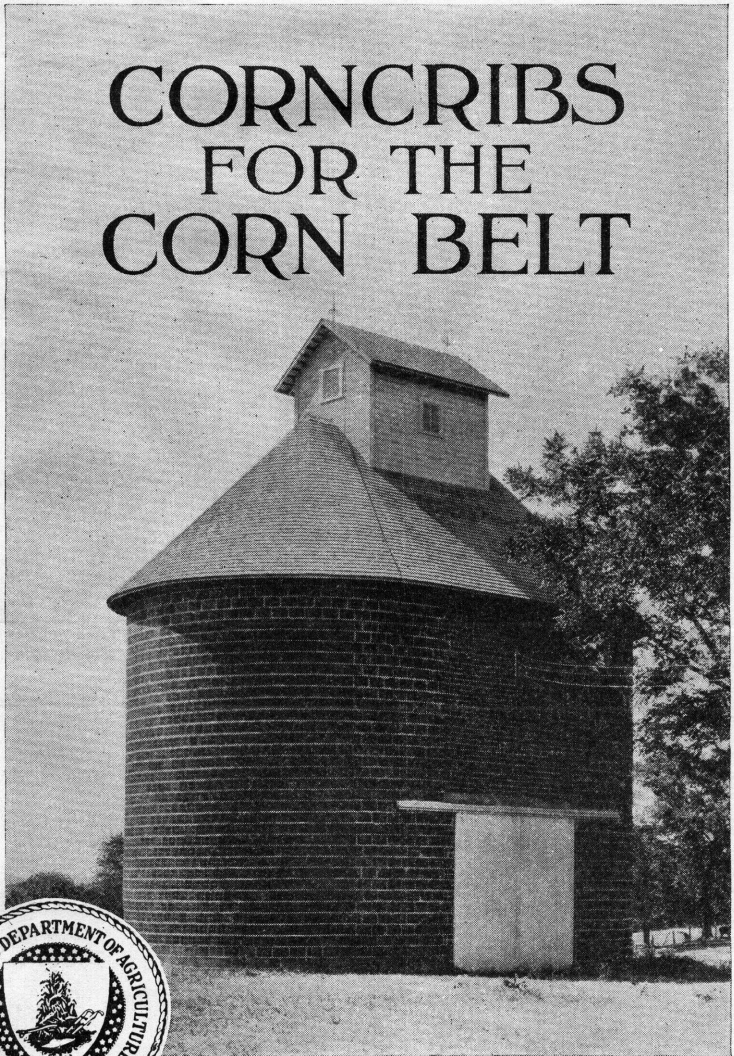
CORNCRIBS FOR THE CORN BELT



BETTER METHODS of building grain-storage structures, explained in this bulletin, will help to avoid losses caused by faulty construction. In the Corn Belt small grains are generally grown in rotation with corn, and storage for them as well as for the corn must be provided. In the same region the use of elevating equipment on farms has made it desirable to use high buildings for storing corn and small grains. This publication presents designs for several types of grain storages adapted to the Corn Belt.

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CORNCRIBS FOR THE CORN BELT

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ON THE FARM is the best place to store corn, because 85 per cent of the crop is fed to farm animals, and only about one-fifth of the corn is shipped out of the county where it is grown. Even when produced as a cash crop, corn is seldom hauled direct from the field to the elevator, hence some provision must be made for storing it until it is to be used or sold.

A substantial, permanent crib is the most economical and satisfactory structure for storing corn. Wire or slat pens and cheap shed cribs are lower in first cost and are useful in emergencies—as when the crop is extraordinarily large or buildings have been destroyed by fire or other cause—but increased loss from weather and vermin may more than offset this initial saving. Studies in Iowa and Illinois have shown that a good substantial crib can be built and maintained at an annual charge of 3 cents per bushel of its capacity.

A well-designed and well-constructed modern crib provides economical storage, ventilation ample to keep the grain in condition and to improve its quality, and protection against losses through weather and vermin. It is durable, of low maintenance cost, safe against damage by wind, storm, or fire, and attractive in appearance. It is also arranged for the use of good labor-saving equipment for filling and emptying the storage spaces.

PRELIMINARY PLANNING

It is unwise to attempt to erect large grain storages without carefully prepared plans. Poor judgment in the selection of the site, lack of knowledge of the strength of materials, and poor workmanship have caused many failures. The most common errors are constructing inadequate foundations, insufficient bracing and tying, and overloading structural members.

The site for the corncrib should be well drained, particularly if the crib is to have a concrete floor. It should be convenient to the road from the field and for stock feeding. The long axis of the crib is usually placed north and south, to get the greatest benefit from the winds and the sun in drying the corn.

FACTORS AFFECTING STORAGE

MOISTURE CONTENT

For safe storage at terminal elevators the moisture content of shelled corn should be not more than about 16 per cent in winter and 14 per cent in summer. The percentage of moisture in ear corn at harvest varies with the season and the dryness of the corn when husked. Iowa corn commonly contains 20 to 25 per cent of moisture in early winter but dries on the cob without damage in properly ventilated cribs. Soft or immature corn may contain as much as 65 per cent of water, and requires special handling.[1] Such corn is often dried artificially or fed early, to avoid losses through its spoilage. Properly built cribs and good handling on the farm reduce the losses.

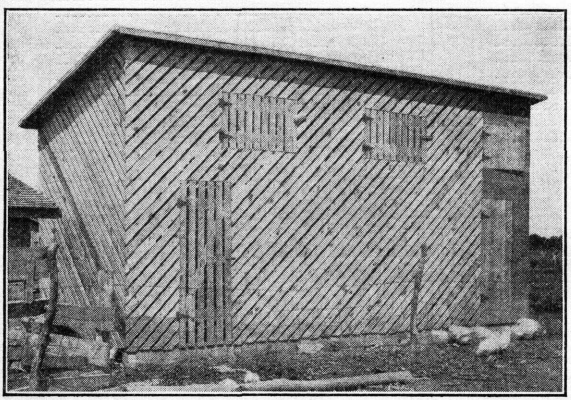

FIGURE 1.—Small corncrib with grain bin in one end, on good foundation but without protection against rats

HARVESTING METHODS

Modern harvesting methods have introduced new problems in grain storage. The old method of hand filling with the scoop shovel limited the height of the crib to 10 or 12 feet. Hand husking was slow and the corn was distributed through long cribs to facilitate its drying.

Modern unloading and elevating equipment have permitted higher cribs and the mechanical corn picker has speeded up harvesting until the daily storage often exceeds 500 bushels. Large masses of corn dry out more slowly, heat more quickly, and cool off less rapidly than smaller masses, with greater danger of spoilage unless the crib is well ventilated. The drying, shrinking, and settling of large masses of corn that is stored before it dries, strain the crib more than when slower methods of filling are used, and sometimes cause its failure.

It is generally believed that corn must be cribbed before it can be shelled, yet demonstrations of new machines have shown that corn can be gathered, shelled, and cleaned, and the stalks shredded in one operation. Should such machines prove practical, their use will add to the problems of properly storing and drying corn.

[1] See Department Circular 333, Handling the Soft-Corn Crop.

TYPES OF CONSTRUCTION

Cribs for storing corn or corn and small grain may be made of wood, masonry, or metal. For emergency or temporarily, ear corn can be stored in cribs made of woven or slatted wire fencing.

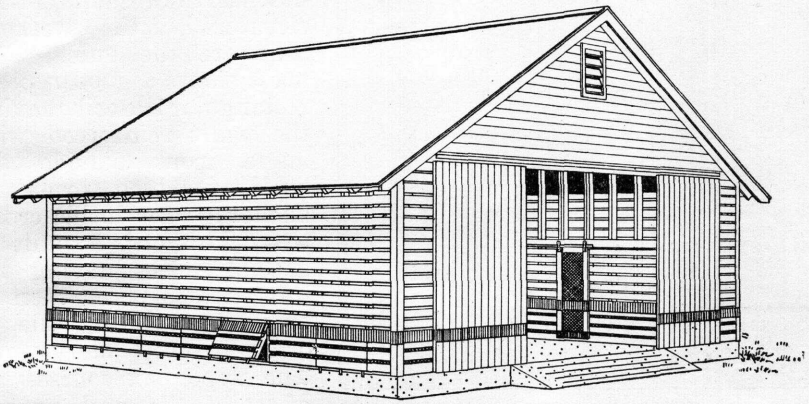

FIGURE. 2.—Double corncrib with capacity of 2,000 bushels of ear corn, and with a 12-foot driveway. The screen and the metal strip above the foundation keep out rats

Early forms of corncribs were built of lumber with shed roofs. (Fig. 1.) Large capacity was obtained by building long cribs or a number of short ones. The height of this type of crib was limited to the height to which corn could be raised with a hand scoop.

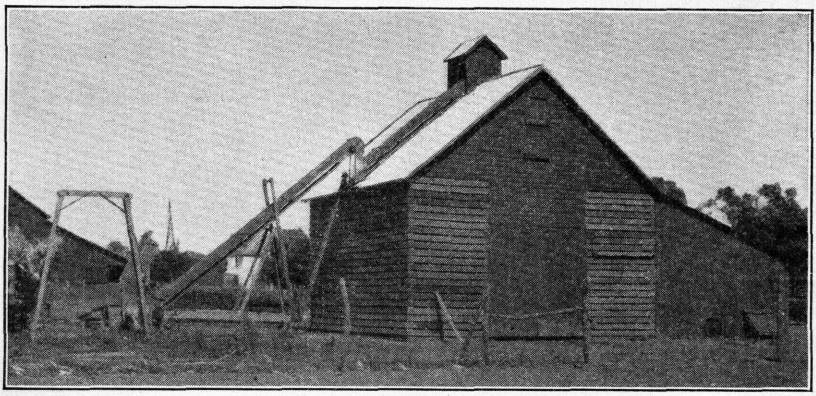

FIGURE 3.—Double crib of early type, with grain bin over driveway, and portable elevator with extra section on roof of crib. Closed wagon shed on side of crib obstructs circulation of air

Later in the development of storage structures, two shed-roofed cribs were joined as shown in Figure 2, separated by a driveway in which light machinery and vehicles could be stored.

Introduction of the farm elevator led to development of high cribs with storage for small grains over the driveway and distribution to the various parts of the structure by spouts from a central point. (Fig. 3.) Cribs were later arranged with elevators inside. (Fig. 4.)

Common building tile with the openings exposed were formerly used for rectangular cribs. Special slotted corncrib tile are now used, particularly for cribs with curved walls. (See cover illustration.) The early tile cribs were without driveways; now driveways and inside elevators with overhead bins are the rule. Figure 5 shows a good type of rectangular tile crib having the walls reinforced with angle irons outside the building which form the anchorage for inside cross-ties. This crib is built of special blocks having the interstices smaller than in ordinary building tile in order to keep out vermin. The upper six courses are of solid tile and protect the top surface of the corn against storms.

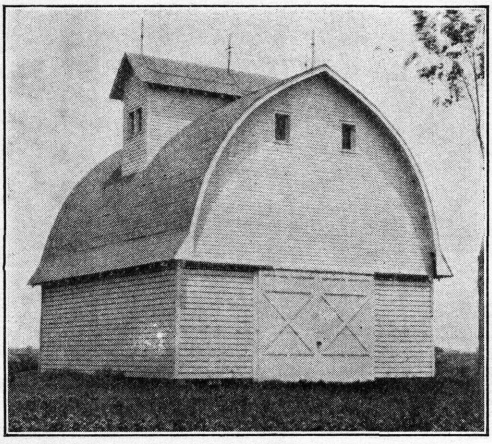

FIGURE 4.—Combined corncrib and small-grain storage, with cupola to give headroom for inside elevator

The most common form of concrete crib is circular or oblong, built of staves and held together by means of exposed iron hoops. (Fig. 6.) The better hoops are galvanized, as black iron hoops leave unsightly streaks of rust on the sides of the crib.

Concrete corncrib staves commonly have either interlocking ends as shown in Figure 7, or square ends as shown in Figures 6 and 8. The latter form is less likely to crack. Some of these staves have rods (fig. 7) and others have louvers (figs. 6 and 8) of concrete or metal to keep rats from entering the openings. Metal rods or louvers should be galvanized to prevent corrosion.

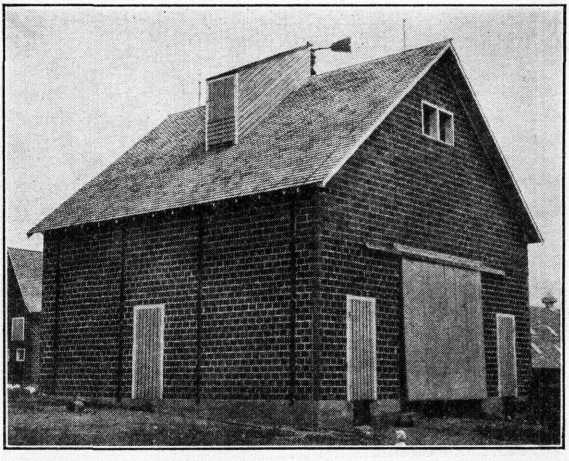

FIGURE 5.—Well-built rectangular crib of hollow tile, with angle irons for tie-rod anchors. Side door gives ready access to crib

More general use of metal cribs has been retarded by numerous examples of flimsy construction and poor-grade metal and galvanizing. Durable cribs of perforated metal in many shapes and sizes may be obtained from reliable firms. Metal cribs of 500-bushel capacity or less are usually circular. Cribs of

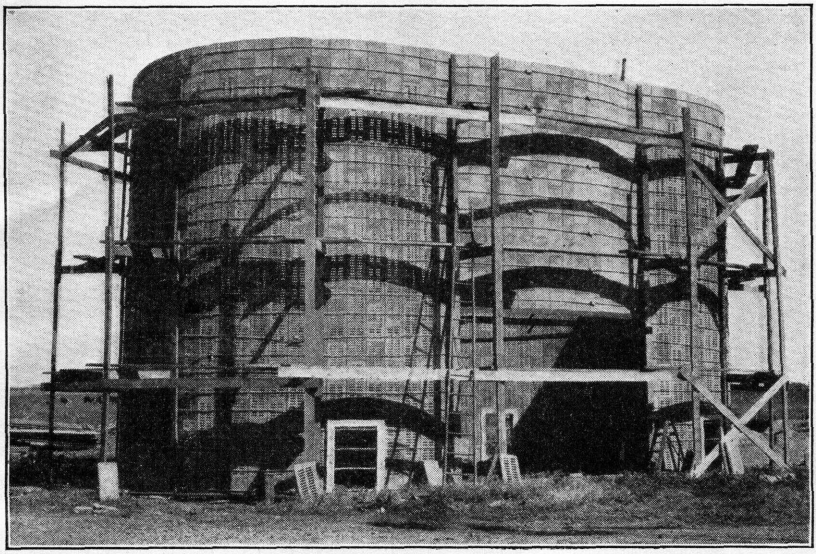

FIGURE 6.—Large concrete-stave crib with central bins, under construction. Hoops are threaded through holes in precast concrete frame for shelling door

larger capacities are rectangular or oblong. (Fig. 9.) A double crib with grain bin over the central driveway is shown in Figure 10.

Emergency cribs made of woven-wire fencing are shown in Figure 11. A better form of wire crib with a metal band which affords protection from rodents is shown in Figure 12.

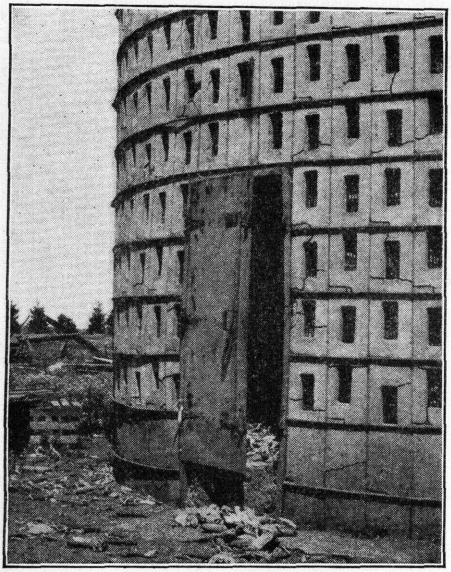

FIGURE 7.—Early type concrete crib of interlocking staves. Poorly designed door frame and poor foundation caused failure shown by cracked staves

SPACE REQUIREMENTS

The size of the crib should be determined largely by the average quantity of corn grown each year and by whether corn is grown for sale or for consumption on the farm. Permanent cribs with a capacity about 5 per cent greater than the average crop are usually more than sufficient to take care of the corn. When unusually large crops are harvested under such conditions about one-fifth of the corn must be stored in temporary cribs inside or outside of farm buildings.

It is common practice to provide 2½ cubic feet of storage space for each bushel of cleanly husked ear corn to be stored. To calculate the ca-

pacity of a crib in bushels of ear corn, multiply by 4 the volume in cubic feet of the available storage space, and divide the result by 10. If snapped or jerked corn is cribbed with the husks on, the capacity of the crib will be reduced about one-fifth. In computing the storage space in a corncrib, the over-all width of the crib should be reduced by 2 inches when 2 by 6-inch studs are spaced 24 inches center to center, by 4 inches when the studs are spaced 16 inches, and by 6 inches when the studs are spaced 12 inches apart.

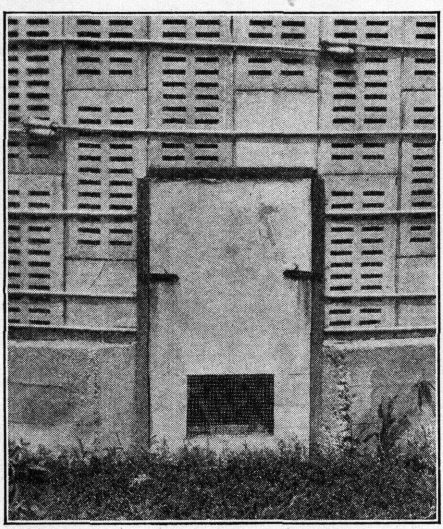

FIGURE 8.—Rectangular concrete corncrib staves, with interstices small enough to keep out rats, resting on substantial concrete foundations; hoops anchored to channel-iron doorframe; screened opening into shelling trench

A bushel of small grain or shelled corn occupies approximately 1¼ cubic feet of space. To calculate the capacity of grain bins in bushels multiply the volume in cubic feet by 8 and divide the result by 10.

While the capacity of the corncrib is determined by farm requirements, the proper width depends on the climate and on the varieties of corn grown. A width of 8 feet is considered standard in most of the Corn Belt, though widths of 6 and 7 feet are not uncommon in Minnesota, northeastern Iowa, northern Illinois, Wisconsin, Indiana, and Ohio. Cribs only 4 feet wide are sometimes used in the Eastern States, partly because of the small quantity of corn raised. In western Kansas and Nebraska a width of 10 or 12 feet is commonly used and generally proves satisfactory.

Table 1 shows the capacities of combined corncribs and granaries of various lengths and heights.

Space for grain-handling equipment should be provided in permanent cribs. Cleaning, grading, and treating seed can be done in the driveway.

The minimum width of driveway for inside installations of elevating equipment is 9 feet. A width of 10 or 11 feet is more satisfactory. Eleven feet is ample and utilizes 12-foot joists economically. Wider driveways are used where oats form a large part of the small-grain crop, but they are not advisable where

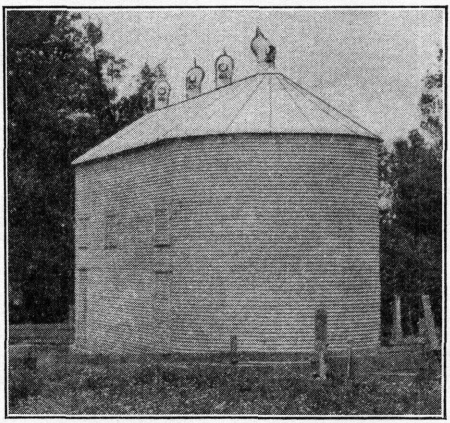

FIGURE 9.—Oblong metal crib. Ventilators on roof connect with metal flues extending to floor of crib

heavier grains are to be stored, because bin floors above wide driveways are likely to be overloaded. Large driveways encourage the storage of all sorts of machinery and junk that interfere with convenient handling of the grain.

STRUCTURAL DETAILS

The essentials of a satisfactory corn and grain storage are strength, dryness, and durability. The loads to be supported are heavier than those in other farm buildings and tend to force out the side walls as well as to break down the floors. The framing should be designed and built to resist safely both the load of the grain when the crib is full and the thrust of the wind when the crib is partly or entirely empty.

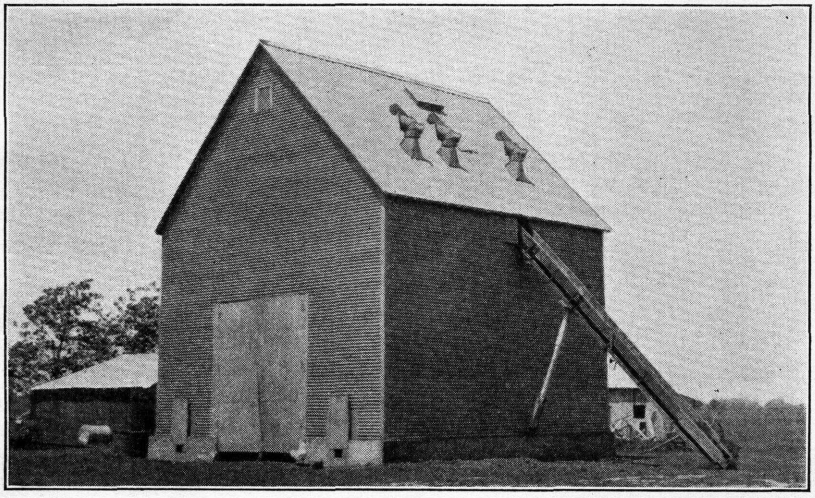

FIGURE 10.—All-steel crib (steel framing, perforated-metal sides, and corrugated roofing) with portable elevator

TABLE 1.—*Capacities of combined corncribs and granaries* [1]

Height of studding in outside wall	Crop stored in—	Capacity per foot of length	Height of studding in outside wall	Crop stored in—	Capacity per foot of length
		Bushels			*Bushels*
10 feet	Bins	34.6	16 feet	Bins	86.6
	Cribs	75.1		Cribs	109.6
	Total	109.7		Total	196.2
12 feet	Bins	52.0	18 feet	Bins	104.0
	Cribs	86.9		Cribs	121.0
	Total	138.9		Total	225.0
14 feet	Bins	69.3	20 feet	Bins	121.3
	Cribs	98.2		Cribs	130.8
	Total	167.5		Total	252.1

[1] For type of construction see fig. 19. Width of each crib, 8 feet; width of driveway, 11 feet; grain bin measured from 10 feet above crib floor (height of driveway) to 4 feet above outside plate; average height of ear corn measured to 2⅓ feet above outside plate.

FOUNDATION

A permanent crib should have an ample, well-made foundation. Poor foundations probably cause more corncrib failures than does any other one thing. Figure 13 shows a concrete foundation which,

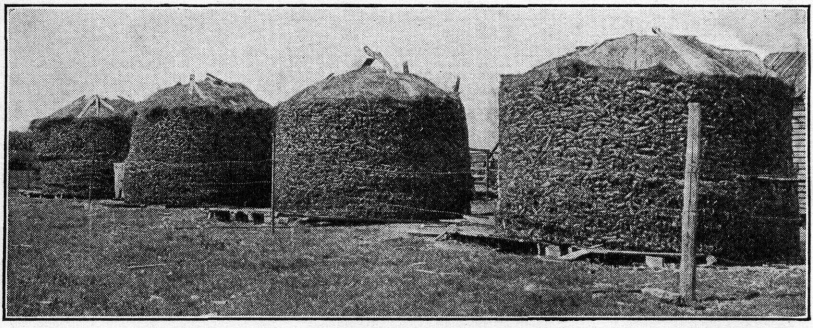

FIGURE 11.—Emergency cribs of woven-wire fencing, on a plank floor which affords excellent harbor for rats. Cheap in first cost but expensive when losses from elements and rodents are considered.

being set on top of the ground, is being undermined by rain and the trampling of livestock. To avoid serious damage to the foundation and building, repairs should be made at once. Standing water may soften the soil under a portion of the building and cause unequal settling. Eave troughs, down spouts, and proper drainage around the building will eliminate this cause of trouble. Figure 14 shows piers heaved out of line by frost. Foundations of uncemented field stones are likely to settle unevenly or may allow the sills to slip.

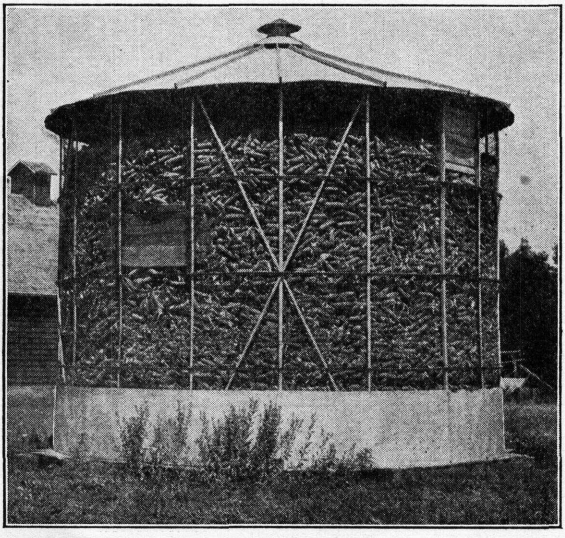

FIGURE 12.—Improved form of temporary crib, with screen-lined floor and metal band around bottom to keep out rats.

Two good types of foundations[2] are shown in Figure 15. Footings should rest on firm ground and be deep enough to avoid heaving caused by frost or undermining by rats or livestock. Ordinarily, the footing should extend at least as far below the ground as the foundation wall extends above, to provide stability. If a wood floor is to be used, the foundation walls should be carried far enough

[2] See Farmers' Bulletins 1279, Plain Concrete for Farm Use; 1480, Small Concrete Construction on the Farm; and 1638, Rat Proofing Buildings and Premises.

aboveground to give good ventilation and long life to the sills, studs, and joists, as indicated in Figure 15, C. Half-inch bolts for anchoring the sills should be set 12 inches into the wall and not more than

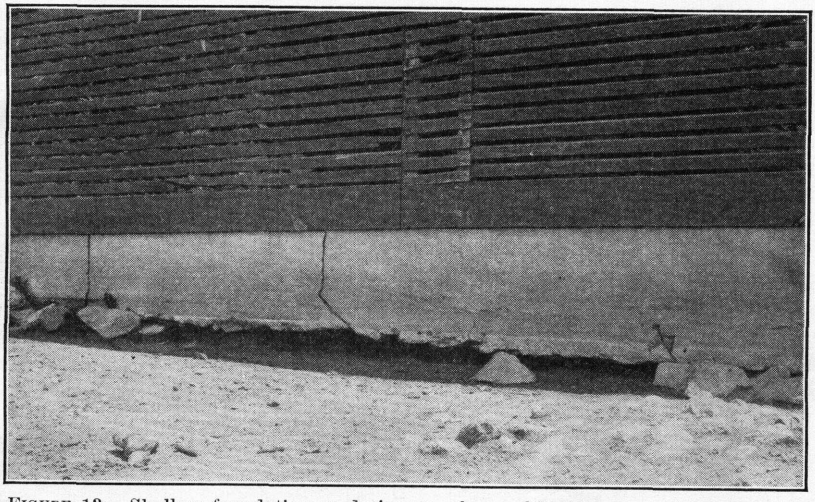

FIGURE 13.—Shallow foundation made insecure by washing away of soil underneath

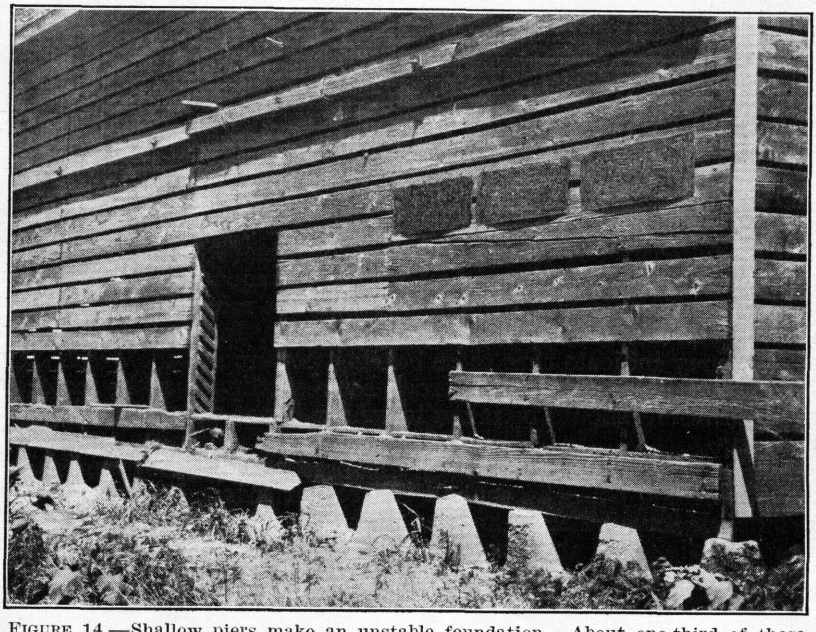

FIGURE 14.—Shallow piers make an unstable foundation. About one-third of these are out of alignment

4 or 5 feet apart. If the foundation is a continuous wall, screened openings should be made to permit circulation of air and avoid rotting of timbers. Footings may not be necessary on some soils, but are generally advisable. If a pit for elevating equipment is to

be provided, the adjacent footings should be placed below the level of the pit.

Where continuous foundation walls are used, as in Figures 15 and 16, 12-inch footings and 8-inch concrete walls are adequate in firm, well-drained soils. On soils which furnish poor bearing the width and depth of the footing should be increased in proportion to the bearing power of the various types of soil, as given in the next paragraph. Where the bearing is not good, it is also well to use reinforcing rods in the footings.

Piers do not furnish as good support as walls. They should be proportioned according to the load to be carried and the bearing power of the soil. The load on a pier may be computed on the basis of the following weights of grain per cubic foot: Ear corn, 28 pounds; shelled corn, 45 pounds; wheat, 50 pounds; barley, 39 pounds; oats, 26 pounds. Loads should be computed for cribs and bins filled to capacity and with about 10 per cent added for the weight of the building. In ordinary practice the bearing power of soils is assumed

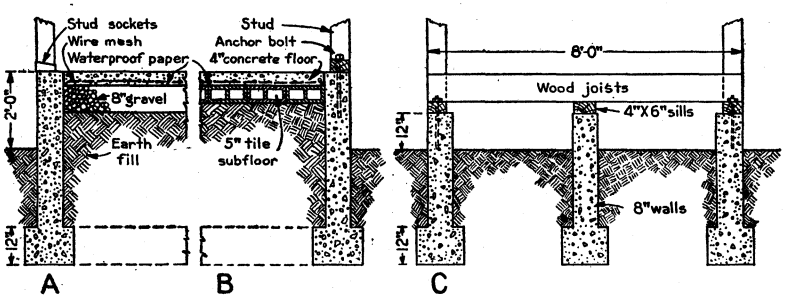

FIGURE 15.—Suggestions for foundations and floors. A, Foundation and concrete floor on 8 inches of gravel or broken-stone fill; stud sockets or anchors used; depth of foundation varies with ground conditions. B, Concrete floor on building tile for dryness; wood sills bolted to foundation. C, Foundation of three continuous concrete walls for high crib with wooden floor

to be as follows: For hardpan or firm dry sands, clays, gravels, or mixtures of them, not more than 3 tons per square foot of bearing area; for ordinarily well-drained subsoils, not more than 2 tons; for alluvial soils or wet clay, not more than 1 ton. In some localities, experience may indicate that these bearing powers are too great. Unless a foundation rests on bed rock some settling may be expected, and precautions should be taken to render it not only slight but also uniform.

Metal cribs should be strongly anchored to concrete foundations. The sills should be set in asphalt to prevent entrance of water from the sides or some other means should be used to drain the water off the foundation and prevent its entrance into the crib at the foundation line.

FLOORS

All floors should be sufficiently smooth to provide a good surface for shoveling. Concrete floors laid over building tile or on 6 to 8 inches of gravel or broken stone fill (fig. 15, A and B) are commonly used in modern cribs. It is important that these floors be well drained and where the soil is moist there should be two or three layers of waterproof paper just under the concrete.

Wood floors (fig. 15, C) should be of seasoned lumber and high enough above the ground to provide no harborage for rats.

FRAMING

A satisfactory corncrib or granary must have a substantial frame. A common mistake, resulting in many failures, is building corncribs

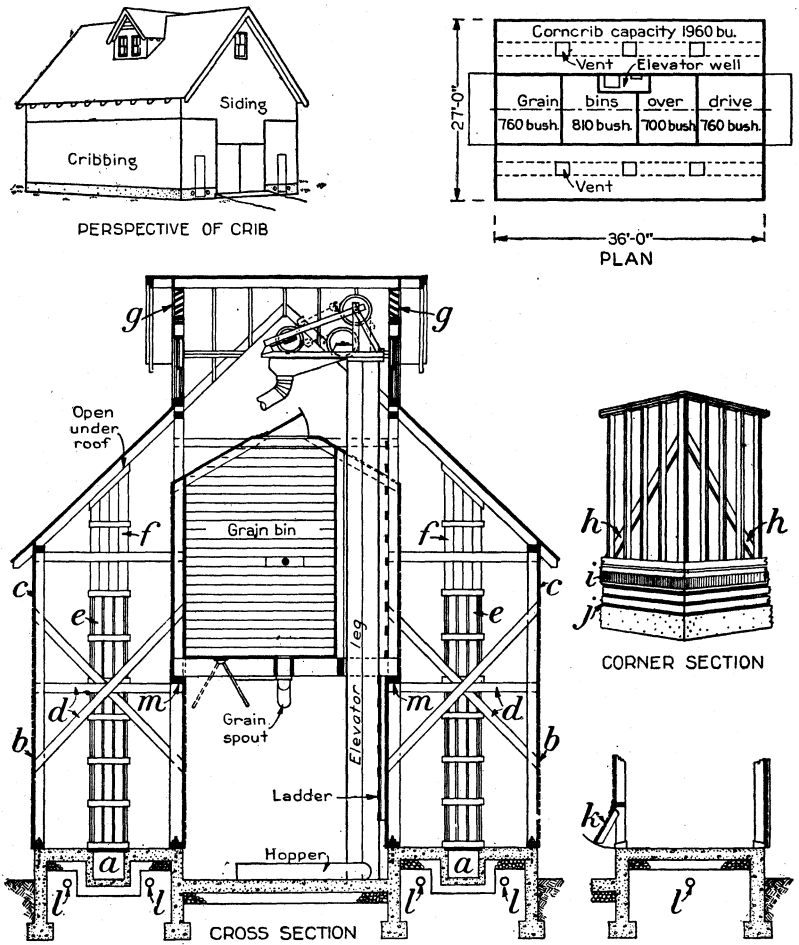

FIGURE 16.—Construction of frame corncrib and granary, design No. 2587; *a*, Shelling trench; *b*, bevel-edged cribbing; *c*, solid sheathing; *d*, cross bracing; *e*, slatted ventilators; *f*, tightly boarded ventilator shaft; *g*, louvers; *h*, corner bracing; *i*, 8-inch metal-band rat proofing; *j*, ½-inch wire-mesh rat proofing; *k*, shelling door; *l*, tile drain; *m*, wall plate supporting grain bin

too tall, particularly when inexperienced labor is used. When the crib is to be 18 feet high or more, the construction should be supervised by a competent builder.

Green lumber should not be used, as shrinkage may cause objectionable cracks and warping. Woods most commonly used are, in order of their relative strength, oak, yellow pine, fir, spruce, common white pine, hemlock, and cottonwood. Because of its durability

many farmers use oak for sills and joists and for the studs of the outside wall. The life of less durable kinds of wood can be greatly increased by proper treatment with creosote or other wood preservatives.[3]

SILLS

Wood sills should be attached to the foundation by bolts. They should be of durable material, usually at least 3 inches thick, and as wide as the studs. Ventilation around them and protection from moisture increase the life of sills and joists. Figure 17, C shows how drainage and ventilation may be improved by use of a shallow concrete subsill with drain openings or weep holes.

If the floor is of concrete the sills may be omitted and the studs anchored to the foundation walls by stud sockets (fig. 17, A and B) set firmly in the concrete and spiked to the studs. Rotting of the lower ends of the studs may be avoided by dipping the ends in a preservative.

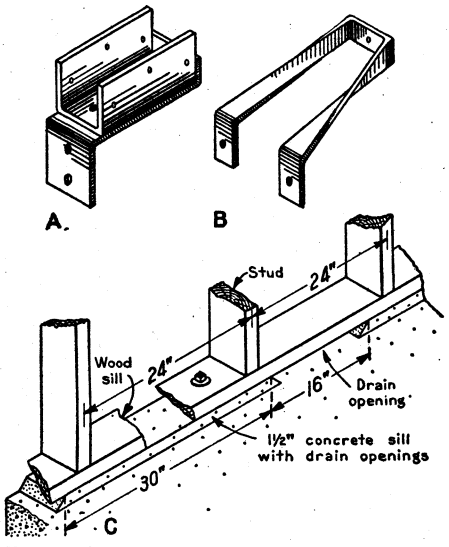

FIGURE 17.—Types of anchorage for studs: A, Pressed-metal anchor; B, strap-iron anchor; C, wood sill bolted to concrete foundation, with weep holes through concrete subsill for floor drainage

FLOOR JOISTS

The size of floor joists required depends on their span and the load to be supported. In deep bins and cribs the arching action of the grain tends to put part of the load on the walls, decreasing the load on the joists. Table 2 gives suggested sizes for joists with a strength equal to that of good-quality oak or yellow pine. Larger sizes or closer spacing is required for timbers of less strength. Home-sawed joists should be cut 2½ or 3 inches thick, since the greater thickness provides better bearing and longer life. A 3 by 8 inch joist is approximately as strong as one 2 by 10 inches.

STUDS

If cribs are properly cross braced, it is common to use 2 by 6 inch studs spaced 24 inches on centers in cribs up to 18 feet in height from foundation to outside wall plate. In higher cribs heavier studs should be used, 2 by 8 inches for heights up to 24 feet. It is difficult to shovel or scoop between studs that are less than 18 inches from center to center.

Formerly, in corncribs with grain bins over central driveways, the studs next to the driveway often were continuous from sill to top of bin, and the bins were supported on ribbons let into the studs or

[3] See Farmers' Bulletin 744, Preservative Treatment of Farm Timbers.

on blocks spiked to the sides of the studs. The former method weakened the studs and the latter placed too much strain on the nailing. It is better practice to use short studs and plate off below the bins, as shown at *m* in Figure 16.

TABLE 2.—*Suggested sizes of floor joists for corncribs*

Type of foundation	Height of crib to outside wall plate	Spacing of joists	Size of joists if length is—	
			8 feet	10 feet
	Feet	*Inches*	*Inches*	*Inches*
2-wall[1]	8	24	2 by 10	
	12	24	2 by 12	
	12	12	2 by 10	
3-wall[2]	12	24	2 by 8	2 by 10
	16	24	2 by 10	2 by 12
	20	18	2 by 10	2½ by 10
	20	24	2½ by 10	2½ by 12

[1] 1 wall under each line of studding.
[2] 1 wall under each line of studding and 1 wall supporting middle of joists.

Reinforced-concrete lintels and girders are sometimes used to support grain bins over the driveway in a masonry crib. These lintels and girders must, of course, rest on substantial footings and columns. This type of construction is very satisfactory if properly designed and built by experienced men, but poor design or workmanship has caused many failures. Steel I beams of proper size are very satisfactory for supporting grain bins over driveways. Second-hand bridge beams can sometimes be secured at small cost.

BRACES AND CROSSTIES

Omission of bracing is a common fault in storage structures and often results in racked buildings (fig. 18) or bulged walls. Two kinds of braces are needed: (1) Diagonal braces nailed to the studs (fig. 16, *h*) to resist wind[4]; and (2) crossties between studs to resist the outward pressure of the grain (fig. 16, *d*).

Some good arrangements of crossties for cribs of various heights are shown in Figure 19. All ties should be well fastened at the ends. The bottom of the cross braces should be high enough for a man to walk under, a minimum height of 6 feet being desirable.

Ear corn when placed in the cribs settles as it dries and tends to wedge together. The settlement sometimes is as much as 2 feet or more, depending on the original depth and the dryness of the corn. If crossties are placed on every stud, they may support the entire load of corn above them while the corn below settles away. This increases the liability of broken ties, and the danger from falling corn when the crib is being emptied. Therefore crossties should not be placed closer than 4 feet and should be designed to support heavy loads without damage. Even heavy crossties can be broken by sudden sliding of large masses of corn. To avoid this danger the grain should be kept moving steadily from the top while the crib is being emptied.

[4] See Leaflet 87, Wind-Resistant Construction for Farm Buildings.

Iron rods 8 to 10 feet apart and attached to stay timbers are often used for crossties. These rods must be supported similarly to those in Figure 19, D, or the weight of corn above will pull loose their anchorage or pull in the side of the building. Stay timbers spiked

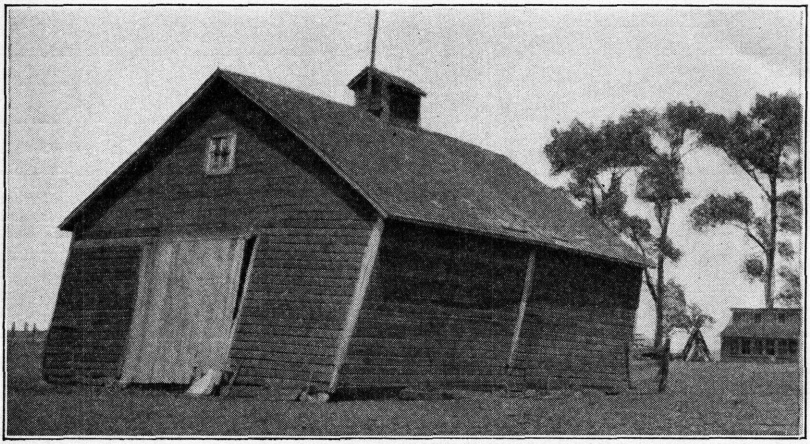

FIGURE 18.—Bracing cribs when they are built avoids the conditions shown. Undermining of shallow foundation by rats hastened this failure

outside the studs (fig. 14) should be protected by flashings to prevent water from getting behind them. Sometimes the stay pieces are fastened on the inside of the studs by **U** or hook bolts, as shown in Figure 20.

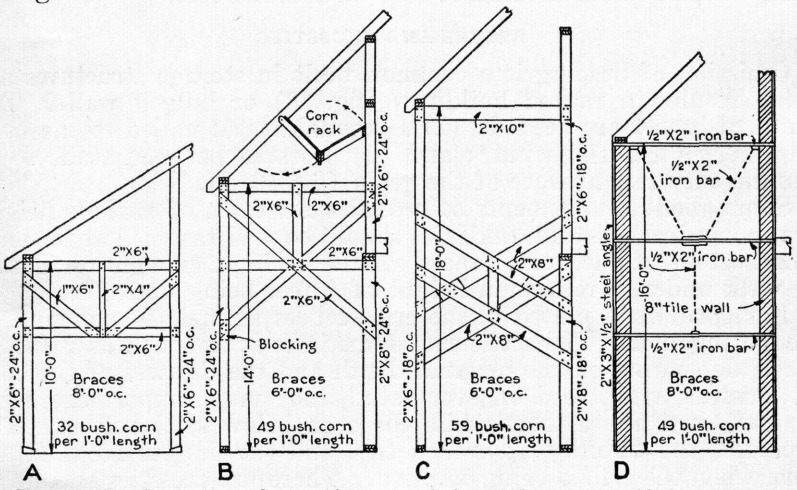

FIGURE 19.—Suggestions for bracing cribs 8 feet wide: A, For 10 feet height; B, for 14 feet height; C, for 18 feet height; D, for tile crib 16 feet high. The letters "o. c." denote "on center" and apply to spacing

One recommended form of cross bracing for masonry and metal cribs is shown in Figure 19, D. Unsupported horizontal ties of one-half by two inch bars usually will fail because of the weight of corn on them, but are safe if the vertical and diagonal supports shown by

dotted lines are added. Joints must be secured with bolts not smaller than five-eighths inch. It is good practice to use pilasters to stiffen the walls in large masonry cribs.

SIDING

Thorough curing of corn requires an abundance of fresh air to carry away the moisture. Siding boards on corncribs are spaced one-fourth to one and three-fourths inches apart to permit circulation of air. Siding may be put on horizontally, vertically, or diagonally. As a rule horizontal cribbing slats 4 to 6 inches wide with edges beveled to aid in keeping out rain are used on the outside wall. (Fig. 20.) Vertical or diagonal siding does not need beveled edges. Common boards, placed horizontally, are ordinarily used on the driveway side. The siding should be well nailed, with tenpenny nails. Vertical siding permits rain to drain off readily, but is little used except on small cribs. Diagonal siding braces the walls, but requires somewhat more labor in applying and is not attractive in appearance. To protect the top of the corn pile from rain or snow after the corn in a high crib has settled, the upper 2 to 4 feet of the crib should be boarded tightly, as shown in Figures 16, *c* and 21.

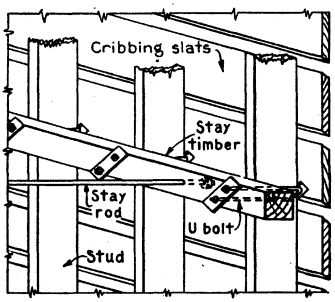

FIGURE 20.—Stay timber secured to studs with U bolts, the tie rods extending through the timber

Openings or doors in the side walls or at the ends of shelling trenches (fig. 16, *k* and *a*) should be provided to avoid the necessity of tearing off siding whenever corn is shelled. This practice causes rapid deterioration of the crib. (Fig. 14.)

OVERHEAD BINS

The boxing or sheathing of the small-grain bins should be well-dried shiplap or matched lumber. Only dry lumber should be used, and it should be carefully piled to prevent injury from rain before it is put in place. The sheathing is best placed on the inner side of the bins more than 10 feet deep, otherwise the pressure may loosen the nails.

Hopper-bottom grain bins are hardly necessary if the grain is moved only once a year. Where it is moved frequently, as on a stock farm, one or more hopper bins may be convenient. A semihopper bin may easily be provided by placing the joists as shown in Figure 22, A. The crossed joists help to brace the center of the structure with little added cost or loss of space.

The length of span of the overhead joists is determined by the width of the driveway. For economy in construction this width should be the minimum that will meet the requirements. Very wide driveways require especially heavy joists, steel girders, or some form of truss to support the grain overhead. The supports should be framed by an experienced man and care taken to make strong joints.

Figure 22 suggests three ways of supporting bins when the maximum depth of small grain is not more than 12 feet. Joists for oat

bins need not be so large as those shown in Figure 22, but in the Corn Belt the bins may be needed for wheat or shelled corn and should be strong enough for such grains. When bins 12 feet or more in depth are needed to provide the desired capacity, it may be more economical to store the grain in another building.

ROOFS

Gable roofs are most commonly used on wood corncribs. On small cribs a pitch of approximately 8 inches to the foot is often used. (Figs. 1 and 18.) Half pitch (12 inches to the foot) is used most commonly on larger cribs and cribs intended to be filled by an elevator. Sometimes a gable roof with ridge perpendicular to the drive-

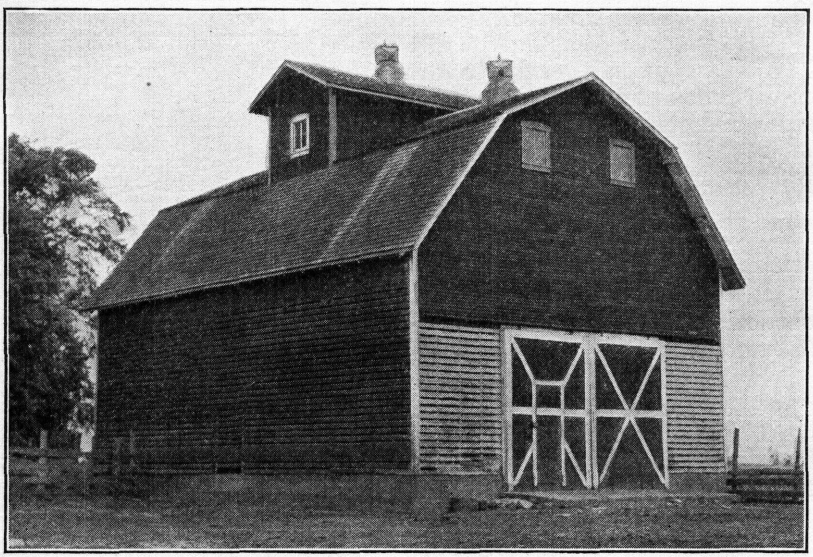

FIGURE 21.—Gambrel-roof corncrib and granary, with small section of tight sheathing below plate for storm protection

way will give space, without a cupola, for the elevator head.

The gambrel roof (fig. 21) is used to advantage when large bin storage is needed, or to match the style of other buildings. A gothic roof (fig. 4) has the same advantage, but shingles may not lie flat on such a sharply curved roof.

If prepared roll roofing is used it should be of good quality, not easily torn off by wind. Good-quality corrugated iron and other metal roofings are satisfactory for corncribs when properly laid to exclude rain and snow.

CUPOLA

A cupola is generally used to permit placing the elevator head high enough so that the grain can be spouted to any part of the building with less trouble and expense than cross conveyors require. The cupola also aids in ventilating the building by permitting the vapor rising from the drying grain to escape through the louvers (fig. 16, *g*) or windows.

The width and length of the cupola will depend on the space required for the elevator leg and head. (Fig. 16.) Some elevators require a cupola extending the full width of the driveway (figs. 4 and 21), while others do not. (Fig. 5.) For best appearance, the center of the cupola should be at the ridge of the main roof. When possible, consult the manufacturer's layout for the elevator to be used before building the crib. It is seldom advisable to build a cupola less than 6 feet wide (measured parallel to ridge of main roof); 8 feet is better and does not look too large on a crib 36 feet or more long. An elevator leg having buckets or cups 8 by 16 inches—the common size—requires a working space 21 to 30 inches wide and a minimum of 7 inches clearance behind. Elevator heads are usually 5½ to 6½ feet long. The height of the cupola will depend on the length and width of the crib. On a crib 30 feet or less in width and not over 40 feet long, with half-pitch roof, the cupola walls should extend 2 feet or more above the ridge of the main roof. A half-pitch roof at right angles to the main roof has a good appearance.

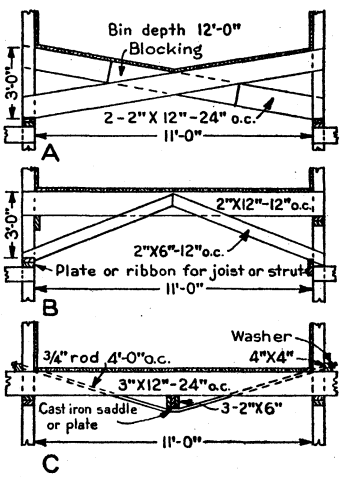

FIGURE 22.—Supports for grain bin of 12 feet maximum depth, over 11-foot driveway: A, Crossed joists forming semihopper bin floor; B, joist with knee braces; C, trussed-beam support

VENTILATION

In some localities and during some seasons it is not possible to leave corn in the field until it has dried out to a safe moisture content. To avoid spoilage, excess moisture must be removed soon after the corn has been cribbed. Removal of moisture depends largely on air movement. Therefore the width of the crib and the provisions for ventilation should be suited to the climate. When the corn is soft, the ears must be cleanly husked so that husks or silk will not interfere with the passage of air through the mass of corn. Normally the greatest spoilage is found below the emptying point of the elevator spout where silks, shelled corn, and other débris tend to lodge and check circulation of air. For this reason as much as possible of the shelled corn should be removed before the corn enters the crib. Some portable elevators have screens that let this material fall outside the crib. The higher the crib, the greater the proportion of corn that will be shelled in filling.

Adjacent buildings sometimes interfere with air circulation around the crib. Tight sheds built against the side of the crib (fig. 3) decrease the rate of drying, but open sheds like that shown in Figure 23 are not objectionable. Placing the building broadside to the prevailing winds and leaving driveway doors open speeds up the drying.

Natural ventilation is inadequate for corn stored in tight bins except perhaps in territory near the southern or southwestern borders of the Corn Belt, where corn usually is reasonably dry when stored.

If the bins above the driveway are not needed for small grain, they can be converted for storage of corn by removing some of the floor boards and putting ventilators through the centers of the bins. Soft corn requires more ventilation than dry corn.

Suggested forms of ventilating flues in corncribs are illustrated in Figure 24. Forms A, B, D, and E are built the full length of the crib and full height of the corn pile. They divide the storage space so that shelling doors are needed on both sides. In long, high cribs the tops of the flues should be braced to the crib walls. Form A may be used in either grain bin or corncrib, as may G if it is closed along the top edge. Forms B, C, and E are commonly used where large air circulation is needed, as in pop-corn cribs; C is stronger than E; form F is especially suited for masonry crib;

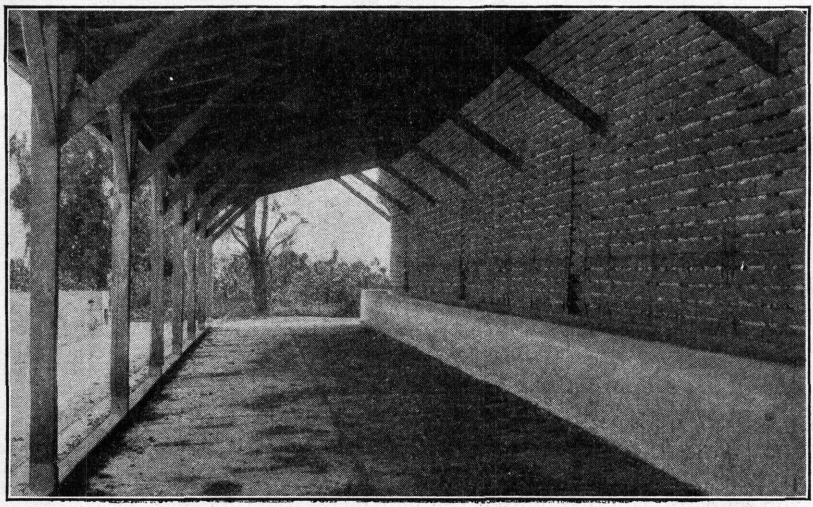

FIGURE 23.—An open feeding shed adjoining corn storage does not obstruct ventilation of crib

forms G and H are used as temporary flues across the crib and when placed at frequent horizontal and vertical intervals through the corn, they facilitate quick dissipation of the moisture, yet are not expensive. Making these flues slightly shorter than width of the crib and placing the ends of alternate flues against opposite walls probably increases the circulation of air. Draintile may be used as horizontal ducts across the crib at several heights.

Much trouble in obtaining proper ventilation in large masonry or metal cribs has been experienced. Since these cribs are often 20 feet or more wide on each side of the driveway, it is necessary to provide interior ventilating flues which are sometimes 25 feet or more in height. In such buildings the flues must be practically self-supporting, as it is difficult to brace them to resist the movement of corn. Form F (fig. 24) is best adapted for use in such cribs, and generally is braced to the wall only at the plate line. The diagonal slats serve as braces and add the necessary stiffness to the flue. The spreading base anchors the bottom of the flue and gives it stability. This flue should have a long life.

Roof ventilators such as are shown in Figures 9 and 21 may be left open during stormy weather and thus lessen the number of trips to the top of the crib to open or close windows. This advantage is important in high cribs.

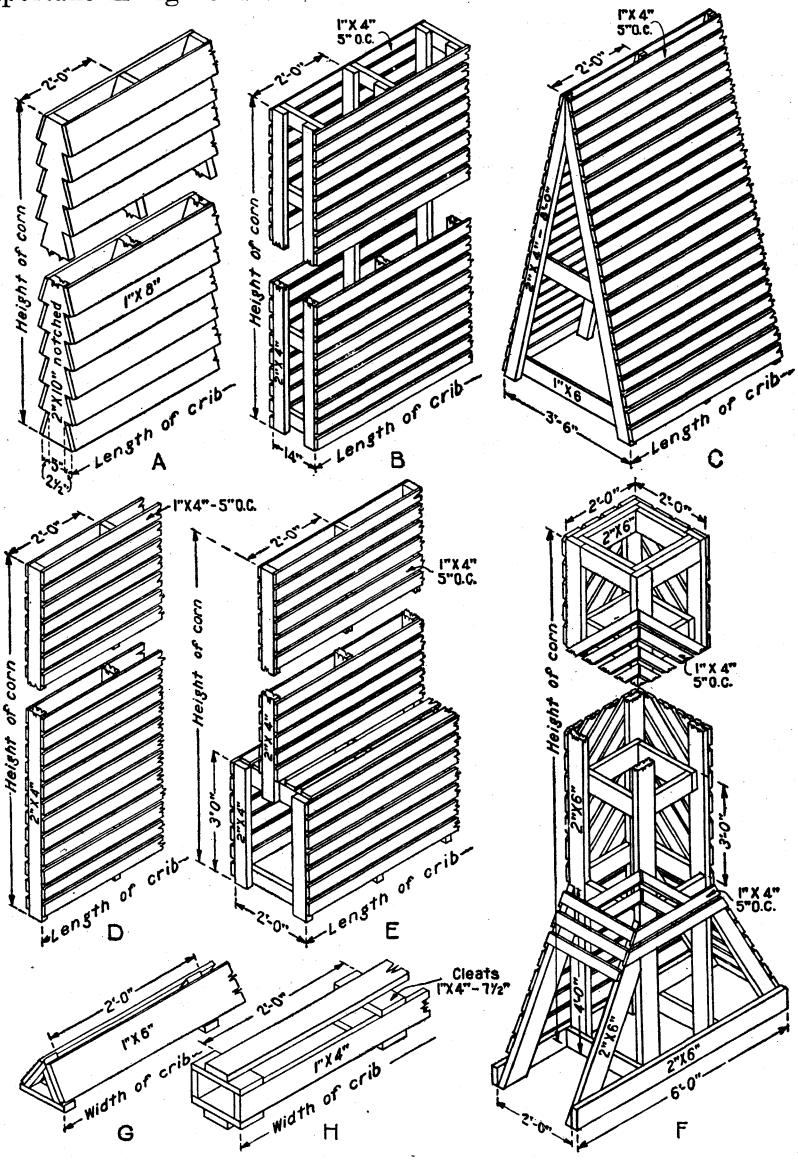

FIGURE 24.—Suggested forms of ventilating shafts

Corn-drying racks (fig. 19, B) are often useful in drying out soft corn. The racks hold the corn for a few days where the air may circulate readily through it before it is dumped into the crib below. Corn husked by machine can not be handled fast enough by this method.

It may be necessary to use fans and heated air to save soft corn. The combination of a warm-air furnace, a power fan, and ventilating ducts has been used successfully in Iowa and Illinois to dry soft corn. A silage blower may be used in an emergency, but is wasteful of power; a more efficient type of fan can be obtained for permanent installation.

The cob holds a larger portion of moisture than the kernels when the corn is first stored, and both dry slowly. For this reason continuous circulation of air at low velocity is most efficient in drying the corn. Fan ventilation is most efficient if the crib is tight and the direction of the air current is occasionally reversed.

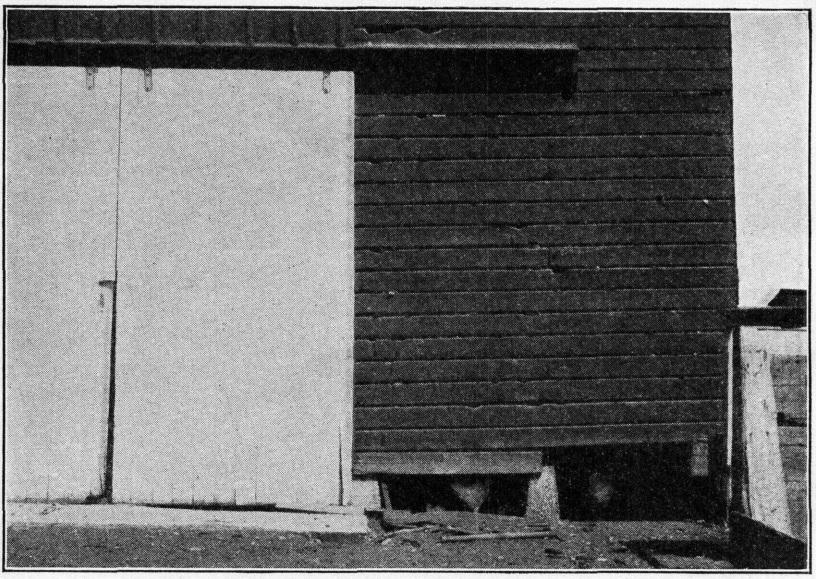

FIGURE 25.—Crib walls damaged by rats

Heavy building paper, tacked on the sides of the crib with lath, helps to confine the air currents as they are forced through the mass of corn. Warmed air will absorb more moisture than unwarmed air, and though high temperatures may hurt germination, this is of little importance with corn for feeding. Corn for seed is more susceptible to damage from heat than are wheat and other small grains, but seed corn should not be dried in the crib.

RAT PROOFING

Rats and mice sometimes cause the loss of a fourth or a third of the corn held overwinter,[5] and also do much damage to cribs. (Fig. 25.)

The use of concrete in the construction of foundations and floors is a great aid in excluding rats. Wooden floors built a few inches off the ground furnish harborage for the pests and if the crib is set too close to the ground, rats in burrowing will pile moist earth against the floor joists and sills, often causing early rotting and failure.

[5] Information on safe measures to use in eradication of rats and mice is given in Farmers' Bulletin 1533, Rat Control.

Heavy wire netting of ½-inch mesh, carried entirely around the crib to a height of 2 feet from the top of the foundation, with an 8-inch strip of galvanized iron just above the netting, will keep rats from getting in through the crib walls. The netting and strip should be carried around the doors and door frames as shown in Figure 2. A wide metal strip will serve the same purpose. (Fig. 12.) Old cribs can often be rat-proofed in this manner at little expense. Masonry and metal cribs offer good protection against rats.

ELEVATING MACHINERY

Most cribs with a capacity of 1,000 bushels or more should have provision for elevators that will handle ear or shelled corn and small grain. The type of elevating machinery to be installed should be selected before the crib is built, and manufacturer's catalogues and layouts should be consulted for space requirements.

Portable elevators may be used with almost any type of crib. In many cases an upper section of the elevator is set permanently in one position on the roof (fig. 3), and housed against the weather. This is practical where the corn can be spouted to all parts of the crib from one cupola. Portable elevators generally have rated capacities of from 250 to about 500 bushels per hour, elevating the grain by drags or scraping bars on an endless chain. The upper end of the leg is provided with a screen that permits the shelled corn and dirt to drop out before reaching the crib. Use of a portable elevator requires space at the side of the crib and a convenient driveway to it.

If the elevator is inside the building, space and clearance must be provided for the wagon jack or dump, the receiving hopper, the elevator leg, and the delivery head and its spouts.

Cross conveyors such as were used in old style long cribs consume an excessive amount of power and give trouble when chains clog and break.

Stationary elevators may be equipped with receiving hoppers like those used on portable elevators or may have a pit and a dump log. (Figs. 26, A, and 27.) With a dump log the headroom required in the driveway is about 2 feet less than that required with a lifting jack. The dump log and pit, however, are difficult to keep clean and free from rats and mice. The best dump logs are built of seasoned planks bolted together, and with space for air to circulate under them to avoid early decay. (Fig. 27.)

Deep receiving pits in corncribs are hard to keep clean and dry and are therefore undesirable except where large quantities of grain must be unloaded quickly to avoid delaying the wagons while the grain is being elevated. Shallow pits with the receiving hoppers placed under the driveway floor are preferable. No pit is needed if the elevator can be started whenever a load is brought in. Receiving pits should be grain tight so that loose grain will not accumulate in inaccessible places.

If the aboveground hopper is used (fig. 26, B) the overhead clearance should be at least 11½ feet to allow raising the front end of the wagon with the lifting jack. The best jacks are now provided with brakes and clutches or similar mechanisms to control the angle of tilting and the rate of grain flow from the wagon, and with safety

devices to hold the wagon in any position. Thus the grain flow may be regulated to suit the capacity of the elevator.

The elevating mechanism of inside stationary elevators consists of steel buckets or cups fastened to an endless belt or chain composed of malleable links. The ordinary open-hook links are not so strong as steel-pin links, and they wear faster because dirt gets into the joints more readily. For ear corn the cups should not be smaller than approximately 7 by 7 by 16 inches. For small grain smaller sizes may be used.

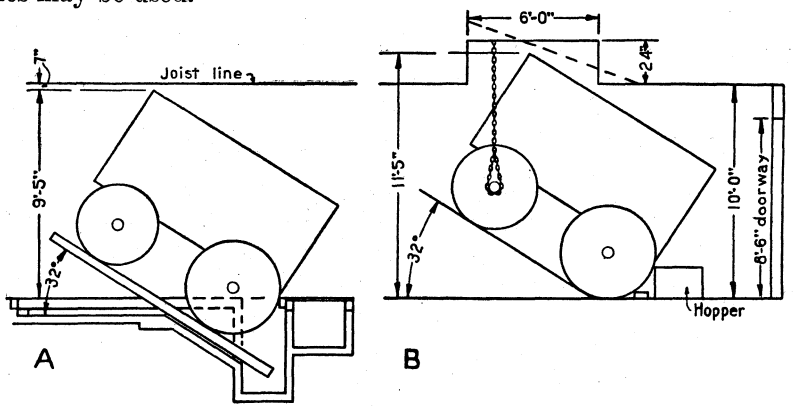

FIGURE 26.—Headroom needed with dump logs and overhead wagon hoist: A, For dump log and shallow pit; B, for overhead hoist with a movable receiving hopper. Bin space may be saved by placing joist as shown by either solid or dotted lines

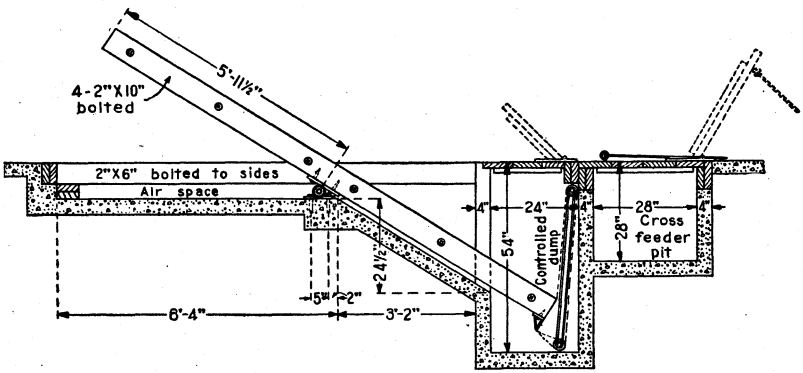

FIGURE 27.—Dump log with shallow pit; note air space beneath log and rat-tight concrete inclosure around pit and log

The elevator leg usually rises straight into the cupola, where the grain is dumped into the delivery head to be spouted to the various parts of the building. Figure 28 shows an arrangement in which the elevator leg is not vertical. This permits a smaller cupola, but increases the power required by the elevator and the wear of its parts in operation. The upside and downside of the elevator may be boxed in one housing about 22 by 26 inches at one side of the driveway (fig. 16) or they may be separated and placed as convenient.

Common arrangements of the delivery head are shown in Figure 29. Common types require a space approximately 4½ feet high and 5½ feet or more wide. The delivery spout should have a drop of at

least 7 feet in 10 feet of run, for delivery at the farthest point of the crib. A much steeper slope should be used for filling most of the crib.

For ear corn the spouts are 16 inches in diameter. The first section is made full circle and the remainder of the spout is made up of detachable sections of telescoping, one-half or three-quarter circle spouting in order to decrease the weight and the labor of handling. The three-quarter round spouting is stronger than the half circle. Lengths of delivery spouts range from 16 feet for cribs 36 feet long to 20 feet for cribs 40 feet long. A 16-inch spout set at the angle required in filling the ends of the crib will not pass between studs spaced 24 inches center to center. Openings for the spout should be provided under the plate by cutting off one or two studs near each end of the crib. The sloping bin top shown in Figure 16 also aids in delivering the corn to the crib.

Gasoline engines of three to four horsepower are commonly used to operate the elevating machinery. Electric motors should be of corresponding capacity and of dust-proof type. Either source of power should be installed with proper safeguards against fire.

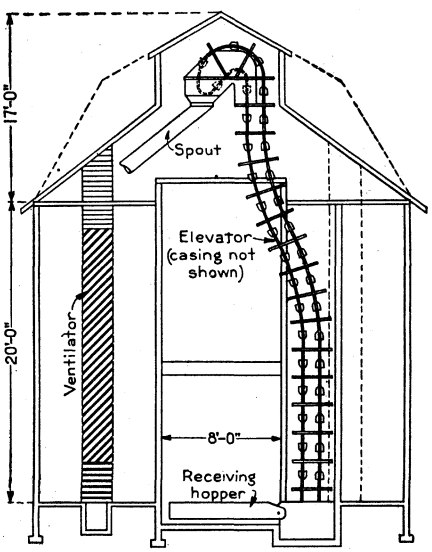

FIGURE 28.—An arrangement of curved elevator leg common in circular masonry cribs. Two-pitch roof may replace cupola

OTHER LABOR-SAVING DEVICES

Corncribs are filled and emptied each year, yet often the only means provided for getting the corn out is tearing off boards. (Fig. 14.) This damages the building unnecessarily. Shelling trenches (fig. 16, A) save much time and labor when corn is to be shelled, particularly in long cribs as much as 8 feet wide. In narrower cribs shelling doors such as that shown in Figure 30, or a horizontal drag (fig. 31), are less costly. Slanting, removable boards like those shown at right in Figures 31 may also be used with hinged doors to relieve the doors of strain from pressure of the corn and to regulate the flow of corn when the crib is being emptied.

Sloping the floor of a corncrib is of no appreciable advantage in moving the corn to doors or to a shelling trench, because ear corn arches and locks together and often a pick must be used to loosen it. For the same reason hopper bins for ear corn are not satisfactory. Snapped or jerked corn flows less readily than clean-husked corn, and damp corn less readily than dry. A bottom opening for removing ear corn should be not less than 18 inches square.

Shelling trenches range from 10 to 22 inches in width according to the make of elevator drag used. Shelling doors should be at least 36 inches high. Loose boards or short cross planks are placed over the trench, and removed as the corn is shelled out. To aid in ventilating the corn the boards are sometimes spaced 1 inch apart and

the trench door provided with an opening screened to keep out rats. (Fig. 8) The floor of the trench is made of concrete so that it may be easily cleaned, and to provide a smooth surface upon which to slide the sheller drag.

Shelling doors are a convenience but may weaken the crib. Figure 7 shows the failure of one crib caused by a large opening. Figure 8 shows an improved design which is more substantial, but puts a heavy strain on the top part of the frame. Figure 6 shows

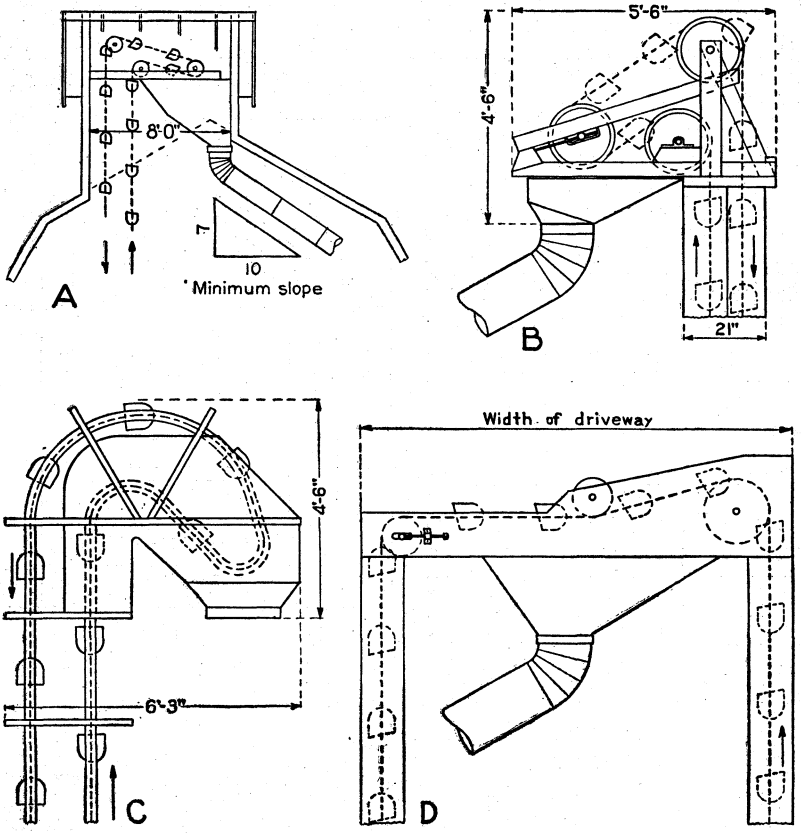

FIGURE 29.—Elevator-head installations: A, Elevator head in offset cupola; B, minimum dimensions for chain-type elevator; C, minimum dimensions for rack-type elevator; D, up and down lines of buckets separated by driveway

a precast, reinforced concrete door frame with holes through which the hoops about the crib are run to relieve the frame from the strain. The hoops are somewhat in the way when the corn is being taken out. They are sometimes cut off and firmly anchored to the frame if the latter is sufficiently reinforced.

On most Corn Belt farms a large portion of the corn is fed to livestock. Figure 23 shows an arrangement which permits great saving of labor and time in feeding.

Figure 32 illustrates satisfactory stops or stays for large sliding doors. These consist of 1-inch iron bars bent as shown and set in the concrete floor. They are not easily injured by wagons or tractors

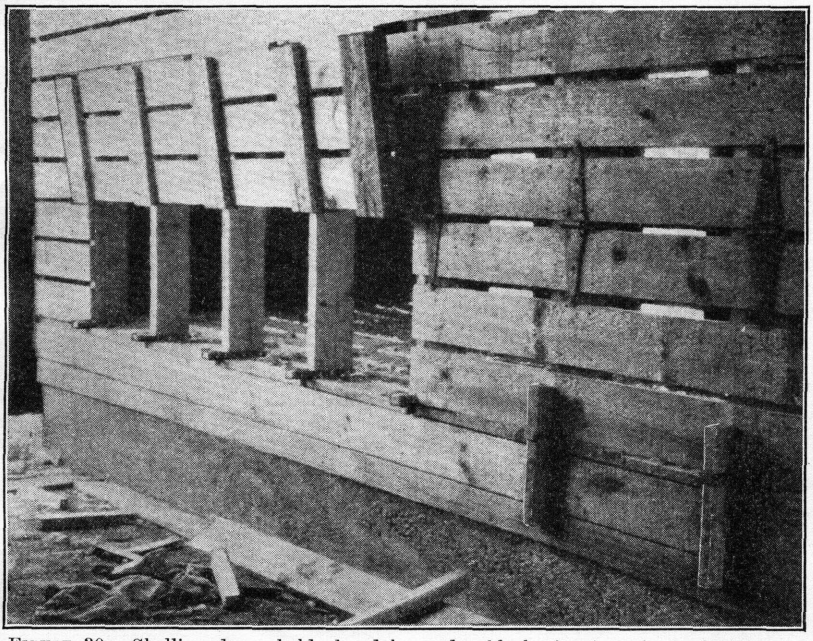

FIGURE 30.—Shelling doors held closed by wedge blocks in strap irons fastened to studs

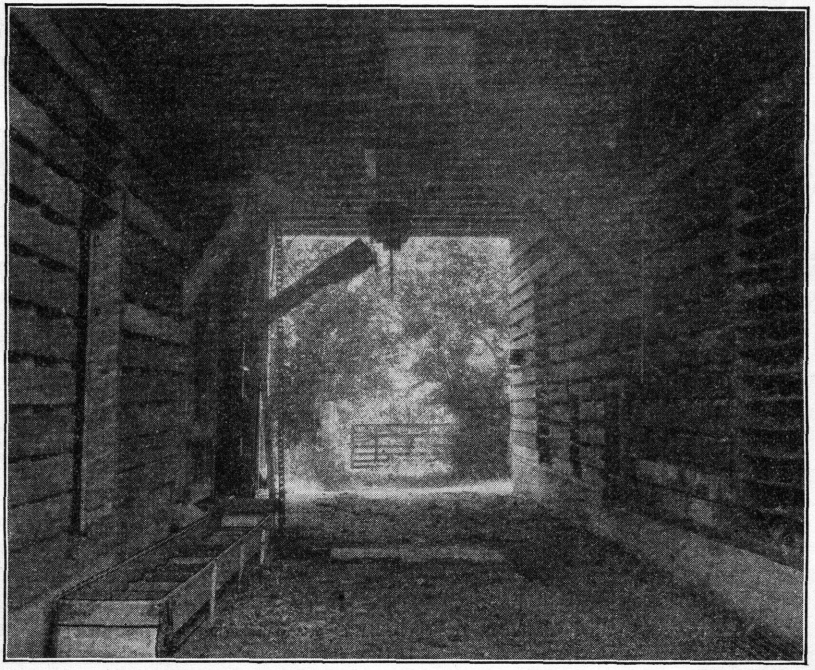

FIGURE 31.—Sheller drag in driveway of double crib, placed to deliver corn to the elevator to be spouted to cribs or sheller

running over them. Several forms of garage door hangers are available for sliding doors that open inward. A small hinged door in a large sliding door (fig. 21) is convenient.

ACCIDENT PREVENTION

Chains, gears, pulleys, and revolving shafts located where persons or stock pass close to them, should be guarded so that clothing, hair, or members of the body will not be caught in them. Shafts and gears near a ladder should be particularly well protected. Ladders should be safe, for many trips must be made to the top of the crib to adjust spouts, to oil or adjust machinery, and to open or close ventilating windows. The rungs should be strong and mortised or let into the rail, and there should be ample space for handhold and foothold. Using the elevator buckets as a ladder involves risk of a fall as well as damage to the buckets. Ladder holes should be at least 22 inches square. Climbing is easier, and machine parts or other heavy loads may be carried to the top of the crib with less risk, especially in high cribs, if there is a smooth wall for the climber to rest his back against. Manlifts or small platform elevators are now being used in some of the larger cribs and are very convenient. Hinging the lower section of a stairway, as is commonly done, with fire escapes, will many times prevent small children from climbing in dangerous places.

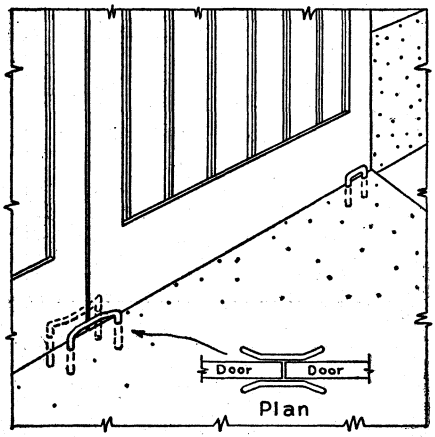

FIGURE 32.—Substantial homemade sliding door stay made from 1-inch iron rod

Where much feed grinding is done, the motor should be inclosed or dust-proof. If a gasoline engine is used, it should be placed outside the building or inclosed in a room lined with metal and properly safe-guarded against fires.

Injury to men emptying the crib, as well as to the cross bracing, may be caused by falling or sliding corn if precautions are not taken. Undercutting the pile is dangerous. The corn should be moved down steadily from the top of the pile.

PLANS AVAILABLE

The plans and illustrations shown in this bulletin may be modified in dimensions, arrangement, and details of construction. Complete working drawings for the cribs shown in Figures 2 and 16 may be obtained from the Bureau of Agricultural Engineering, United States Department of Agriculture, Washington, D. C. Information on costs of labor and material, which differ with time and place, can best be obtained from local carpenters or builders.

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